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A NEW CRAYFISH OF THE GENUS *PROCAMBARUS*  
FROM MISSISSIPPI  
(DECAPODA: ASTACIDAE)

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The existence of the remarkable crayfish described below was first reported by Lyle (1938: 76), who in presenting an abstract of his doctoral dissertation, listed *Cambarus* (*Paracambarus*) *harnedi* [nomen nudum] among the crayfishes occurring in the State of Mississippi. The collection on which Lyle's dissertation was based was housed at Mississippi State University where, for a number of years, it was unavailable for study. Not until Joseph F. Fitzpatrick, Jr. joined the staff of that institution and refurbished the Lyle collection did it become accessible. Through the efforts of Dr. Fitzpatrick and his students, a much larger quantity of material, including collections from all parts of the State, was assembled, and this, together with the Lyle collection, has been deposited in the Smithsonian Institution.

Among the specimens that Lyle had accumulated were two lots (see below) collected from the vicinity of Bayou Barnard by R. N. Lobdell, in which there was a single first form male that bears hooks on the ischia of the fourth pereopods only. Because the limitation of such hooks to this pair of appendages was unique to the then lone member of Ortmann's subgenus *Paracambarus*, *Cambarus* (*P.*) *paradoxus* Ortmann, 1906: 3, Lyle assumed a closer relationship between his species and that of Ortmann than seems probable at the present time. There are several Mexican members of the genus *Procambarus* (= Ortmann's subgenus *Procambarus*), which have been described subsequently, that exhibit this characteristic, and Lyle's

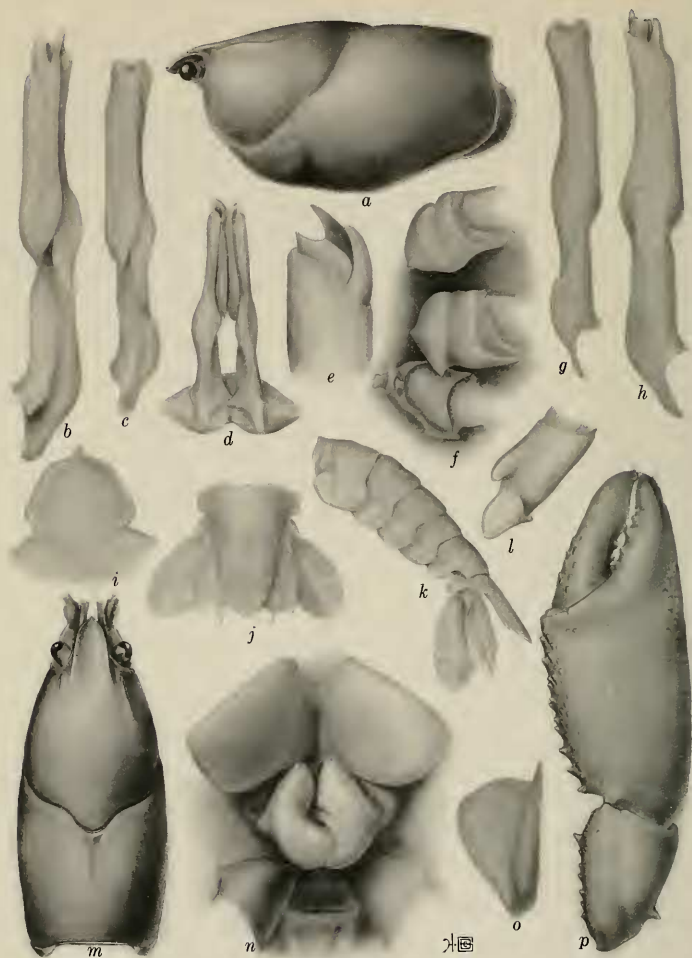


FIG. 1. *Procambarus fitzpatricki* new species (pubescence removed from all structures illustrated). a, Lateral view of carapace of holotype. b, Mesial view of first pleopod of holotype. c, Mesial view of first pleopod of morphotypic male, form II. d, Caudal view of first pleopods of holotype. e, Cephalolateral view of distal portion of sinistral first pleopod of holotype. f, Basal podomeres of third, fourth, and fifth pereopods of holotype. g, Lateral view of first pleopod of morphotypic male, form II. h, Lateral view of first pleopod of holotype. i, Cephalic portion of epistome of holotype. j, Dorsal view of caudal portion of abdomen of holotype. k, Lateral view of abdomen of holotype. l, Basis and ischium of fourth pereopod of holotype. m, Dorsal view of carapace of holotype.

species seems definitely more closely allied to them than to the two crayfishes currently assigned to the genus *Paracambarus*.

An additional character, which is shared only with *Procambarus hagenianus* (Faxon, 1884: 141), also deserves mention. The inner ramus of the uropod bears a prominent distomedian spine which extends much beyond its distal margin (Fig. 1j, k). Whereas the homolog of this spine is occasionally moderately prominent in other crayfishes, in no other members of the genus does it project beyond the margin of the ramus; too, the laterodistal spine is conspicuously longer than in most other species. Other outstanding characteristics are cited in the discussion of relationships.

It is a pleasure to name this distinctive crayfish in honor of Dr. Fitzpatrick in token of his outstanding contributions to our knowledge of the cambarine crayfishes. I am also grateful to him for making the material on which the description is based available to me, as well as for his criticisms of the manuscript. For his helpful suggestions, I am also indebted to Fenner A. Chace, Jr., and for assistance in the preparation of the illustrations, I acknowledge with gratitude the aid of Carolyn B. Gast.

*Procambarus fitzpatricki* new species

*Cambarus* (*Paracambarus*) *harnedi* Lyle, 1938: 76 (*nomen nudum*).

*Diagnosis:* Body pigmented, eyes small but well developed. Rostrum with subparallel to gently convergent margins, lacking marginal spines; acumen short and indistinctly delimited basally. Areola 16 to 27.4 times longer than wide and constituting 31.1 to 35.8 percent of entire length of carapace. Carapace devoid of cervical spines, cervical tubercles very small or absent. Suborbital angle prominent and subacute. Postorbital ridges without spines or tubercles. Antennal scale approximately 1.9 times longer than wide, broadest distal to midlength. Mesial margin of palm of chela with row of nine to 11 tubercles, both fingers with poorly delimited, but massive, longitudinal ridges. Ischia of fourth pereopods only bearing simple hooks; coxae of fourth and fifth pereopods bearing

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n, Annulus ventralis and associated sternites of allotype. o, Antennal scale of holotype. p, Dorsal view of distal podomeres of cheliped of holotype.

TABLE 1. Measurements (mm) of *Procambarus fitzpatricki*

	Holotype	Allotype	Morphotype
Carapace:			
Height	11.6	10.3	11.3
Width	11.7	10.5	11.4
Length	25.0	22.9	24.7
Areola:			
Width	0.4	0.3	0.4
Length	8.6	7.9	8.7
Rostrum:			
Width	3.6	3.5	3.8
Length	4.7	4.6	4.7
Chela:			
Length of inner margin of palm	10.0	6.3	7.8
Width of palm	7.8	5.9	6.6
Length of outer margin of chela	19.0	14.1	17.1
Length of dactyl	9.7	6.7	8.6

prominences. Inner ramus of uropod with two conspicuous spines projecting distally beyond margin. First pleopods slightly asymmetrical, both with well developed proximal lobe and sinistral member with strong subacute proximomesial lobe overlapping caudally corresponding weaker lobe of dextral member; shoulder present at base of cephalic process; pleopods reaching cephalad to or almost to level of second pereopods and bearing subterminal setae; distal extremity bearing (1) prominent, long, subacute mesial process directed distolaterally, extending distally beyond other terminal elements; (2) well developed, distally rounded, corneous-tipped cephalic process directed distally, its apical portion bent slightly laterally; and (3) conspicuous corneous central projection consisting of broad subrectangular, almost bladelike centrocaudal process and narrower curved centrocephalic process; caudal element represented by ridge around caudal base of centrocaudal process. (See *Remarks*.) Sternum of female immediately cephalic to annulus ventralis unadorned, latter with median longitudinal furrow in cephalic half, flanked cephalically by one to four pairs of prominent tubercles.

*Holotypic Male, Form I:* Body subovate, distinctly compressed. Abdomen narrower than thorax (10.1 and 11.7 mm). Width and height of carapace at caudodorsal margin of cervical groove subequal (11.7 and 11.6 mm). Areola 21.5 times longer than wide with single row of punctations in narrowest part. Cephalic section of carapace 1.9 times as long as areola (length 34.4 percent of entire length of carapace). Rostrum inclined cephaloventrally, deeply excavate dorsally, with thickened sub-

parallel margins basally, and rather gently convergent cephalically to apex, marginal spines lacking, and acumen indistinctly delimited basally; upper surface sparsely punctate except basally, usual submarginal row of setiferous punctations present. Subrostral ridges moderately well developed to level of suborbital angle and visible dorsally to base of apical third of rostrum. Postorbital ridges moderately prominent, grooved dorsolaterally, but terminating abruptly cephalically without spines or tubercles. Suborbital angle prominent and acute. Branchiostegal spine moderately large and acute. Carapace punctate dorsally except in polished gastric area and granulate laterally, granules best developed in hepatic area and along cephaloventral margin of cervical groove. Cervical spines absent and tubercles in area only slightly larger than branchiostegal granules. Cephalic section of telson (Fig. 1j, k) with two spines in each caudolateral corner. Cephalic portion of epistome (Fig. 1i) slightly broader than long, resembling isosceles trapezoid, bearing small subacute cephalomedian prominence and with lateral margins elevated (ventrally). Antennules of usual form with well developed spine on ventral surface of basal segment slightly distal to midlength. Antennae extending caudad to second abdominal tergum. Antennal scale (Fig. 1o) about 1.9 times longer than broad, broadest distal to midlength, with widest lamellar area approximately seven times width of thickened lateral portion, latter terminating in strong acute spine.

Ischium of third maxilliped with prominent, simple, stiff setae, not matted.

Right chela (Fig. 1p) with palm inflated, not strongly depressed; lateral margin rounded, not costate; entire palmar area and basal portions of fingers tuberculate, mesial elevated tubercles grading laterally to squamous ones; mesialmost row on palm consisting of 10 projecting tubercles with sublinear series both above and below it; remaining tubercles somewhat scattered; lower surface of palm with moderately prominent tubercle lateral to articular condyle at base of dactyl. Fixed finger with rounded, strongly inflated ridge paralleling general contour of opposable margin, flanked proximally by squamous tubercles and more distally by setiferous punctations; opposable margin with row of five tubercles, third from base much larger than remaining four; row of minute denticles between and distal to tubercles, extending to base of corneous tip of finger; ventral surface with submedian longitudinal groove flanked by setiferous tubercles, and lateral surface with squamous tubercles proximally, grading distally to setiferous punctations. Dactyl, except for being narrower and bearing cluster of tubercles proximomesially, essentially like fixed finger with submedian longitudinal ridges dorsally and ventrally, five tubercles on opposable margin, and mesial margin tuberculate proximally and with punctations distally. Fingers subequal in length to mesial margin of palm.

Carpus of right cheliped longer than broad (7.8 and 5.1 mm) with mesial portion tuberculate, remainder mostly punctate; oblique excavation



on dorsal surface very shallow and flanked by punctations; distal dorso-mesial surface lacking spine; mesial surface with number of tubercles, distalmost larger than others; ventral and lateral surfaces punctate, ventral mesiodistal angle with one spiniform tubercle, and tuberculiform prominence on ventral articular condyle.

Merus of right cheliped tuberculate dorsally and ventrally; dorsodistal surface with two spiniform tubercles; ventromesial margin with row of 11 spikelike tubercles and ventrolateral margin with row of nine, row branching at articular membrane with three tubercles extending distomesially and four distolaterally; few additional tubercles scattered between former two mentioned rows. Ischium with mesial row of three tubercles.

Hooks on ischia of fourth pereiopods (Fig. 11) only; hooks simple, directed proximally, and projecting proximal to distal end of basis. Coxae of fourth and fifth pairs of pereiopods with prominences (Fig. 1f); that on fourth heavy, aligned primarily on longitudinal axis of body with caudal subacute portion directed slightly laterally; that on fifth much less massive, somewhat compressed and directed ventrally from caudo-mesial angle of coxa.

First pleopods (Fig. 1b, d, e, h) as described in diagnosis.

Uropods (Fig. 1j, k) with protopodite bearing two prominent spines; inner ramus with two spines projecting from distal margin, one from lateral angle and longer, stronger one from median ridge.

Sternum between caudal four pairs of pereiopods moderately deep and bearing long plumose setae obscuring, for most part, first pair of pleopods.

*Allotypic Female:* Differs from holotype in following respects: areola 26.3 times longer than broad with two punctations across narrowest part; carapace with widely spaced punctations in polished gastric area; sinistral cephalolateral margin of cephalic portion of epistome with two small angular prominences; chela proportionately shorter and less inflated in area of base of fixed finger, opposable margin of latter with fourth tubercle from base largest and those on opposable margin of dactyl as in morphotype; merus of cheliped with 13 and 17 tubercles in ventromesial row on left and right members, respectively, ventrolateral row with 10 tubercles along basal portion and four in mesial and five in lateral branches, respectively; ischium with ventral row of four tubercles. See measurements.

Sternum cephalic to annulus ventralis (Fig. 1n) broad, shallow, and winglike, without ornamentations but bearing short plumose marginal and submarginal setae, and underlying (dorsally) cephalic portion of annulus ventralis. Annulus subcircular in outline with deep median trough in cephalic three-fifths, flanked cephalically by two pairs of tubercles; sinus originating near median line at caudal end of trough, forming broad sinistral arc across thick caudal wall, and terminating on mid-caudal margin of latter; fossa extending sinistrally near cephalic end of sinus. Median sternite between fifth pereiopods evenly rounded

cephalically and without central elevation or prominent punctations on ventral surface.

*Morphotypic Male, Form II:* Differs from holotype in following respects: cephalothorax not so strongly compressed; cephalic portion of epistome less angular but basically similar; opposable margin of dactyl of chela with third tubercle from base only slightly larger than adjacent ones; tubercles on carpus of cheliped less acute and somewhat reduced in size, with penultimate tubercle on mesial surface largest; merus with non-spiniform tubercles on dorsodistal surface, ventromesial row with 12 and 14 tubercles on left and right members, respectively, ventrolateral row with eight tubercles along basal portion and six in each branch; ischium with row of four tubercles; hooks on ischia of fourth pereiopods less prominent but equally well defined; coxae of fourth and fifth pereiopods only slightly reduced. See measurements.

First pleopods (Fig. 1c, g) slightly asymmetrical, reaching coxae of second pereiopods; proximal and proximomesial lobes prominent, with sinistral member more prominent and acute than in holotype; cephalic surface without prominent shoulder at base of cephalic process; non-corneous terminal elements consisting of distolaterally projecting mesial process and distally directed, broad cephalic process projecting clearly beyond tip of compound, extremely broad projection: centrocaudal process forming truncate ridge along distal caudolateral margin, centrocephalic process slightly broader than distal portion of mesial process, and situated between cephalic process and centrocaudal process, projecting distally slightly beyond latter; caudal element not distinctly delimited from centrocaudal process. Subterminal setae weak.

*Color Notes:* Ground color greenish brown with carapace and chelipeds darker brown than abdomen and remaining pereiopods. Dorsum of carapace chocolate brown, becoming olive toward ventral margin of branchiostegites. Both hepatic and branchiostegal areas with small, irregular, dark brown spots. Dorsum of abdomen with narrow, median longitudinal, pale chocolate band tapering caudally to end on base of telson. First abdominal tergum with pair of short, almost black, bars flanking median stripe; remaining terga with paired oblique (cephalomesial to caudolateral) dark bands flanking median stripe, successively paler toward telson; second through sixth epimera also with narrow, dark, longitudinal stripe at base, and each epimeron darker caudoventrally. Both rami of uropods with dark lateral margins, median ridges, and distal spines. Chela dark brown dorsally with even darker tubercles; upper surface of merus and carpus also dark brown, former fading to olive proximally and to pale green below; remaining pereiopods pale green below, darker green above, and with irregular brown areas along upper margins of merus and more distal podomeres.

A second color phase of yellowish tan and dark brown exists in some individuals; however, there seems to be little variation in the pattern.

*Type-locality:* Roadside ditch at junction of State Rte. 67 and Woolmarket Road, just north of D'Iberville, Harrison County, Mississippi.

*Disposition of Types:* The holotypic male, allotypic female, and morphotypic male are deposited in the National Museum of Natural History (Smithsonian Institution), nos. 131205, 131206, and 131207, respectively. The paratypes, consisting of three males, form I, three males, form II, nine females, one juvenile male, and two juvenile females are also in the Smithsonian collection.

*Size:* The largest specimen available is a female having a carapace length of 27.4 mm. The largest first form male, the holotype, has a corresponding length of 25.0 mm, and the smallest first form male, 21.5 mm.

*Range and Specimens Examined:* *Procambarus fitzpatricki* is known only from the southern part of Mississippi between the Wolf and Pascagoula rivers. HARRISON COUNTY—Type-locality, 18 July 1968 (2 ♂ I, 1 juv. ♀); 8 August 1968 (1 ♂ II) H. H. Hobbs III, coll. Strawberry field near Bayou Bernard, 15 February 1933 (1 ♂ I, 4 ♀, 1 juv. ♂, 1 juv. ♀) R. N. Lobdell, coll.; date unknown (4 ♀) collector unknown. GEORGE COUNTY—3.2 mi. N of Black Creek on State Rte. 57, 11 June 1968 (1 ♂ II) H.H.H. III, coll. STONE COUNTY—8.9 mi. W of Wiggins on State Rte. 26 at junction with U.S. Hwy. 49, 12 June 1968 (1 ♂ I, 1 ♀) 30 July 1968 (2 ♂ II, 1 ♀) H.H.H. III, coll.

*Variations:* The chief variations noted are in the arrangement of the tubercles along the opposable margins of the fingers of the chelae; in a few specimens they are more numerous than in the holotype, and, in some, in which the larger tubercle on the fixed finger is even more strongly developed than in the latter, the opposing tubercle on the dactyl may be suppressed, resulting in hardly a trace of a gap between the fingers when they are brought together; also in some specimens, the usual distal tubercle (lacking in the holotype and morphotype) at a lower level on the fixed finger is present. Variable also is the outline of the cephalic portion of the epistome, which while generally retaining the isosceles trapezoidal contour, may bear secondary angles laterally, and in one specimen a small projection is situated lateral to the cephalo-median one. An examination of the measurements presented for the allotype indicates a shorter and less robust chela than that in the holotype, and this is typical of the females of the species. The annulus ventralis has from one to four pairs of tubercles cephalically, flanking the longitudinal trough.

*Relationships:* *Procambarus fitzpatricki* has its closest affinities with members of the Gracilis Section of the genus: *P. gracilis* (Bundy, 1876: 5), *P. hagenianus* (Faxon, 1884: 141), *P. simulans simulans* (Faxon, 1884: 112), *P. simulans regiomontanus* Villalobos, 1954: 289, and *P. tulaneii* Penn, 1953: 163. This is evident in the conformation of the carapace, and, to a lesser degree, in that of the chela. As in most members of the genus, the strongest evidence of relationship is seen in the structure of



the first pleopods and the annulus ventralis. Even though the pleopods are somewhat asymmetrical, and in other respects slightly atypical of the Section, they share a very prominent proximal lobe, a shoulder at the base of the cephalic process, and a conspicuous bladelike centrocaudal process. *Procambarus fitzpatricki* lacks the dense, matted setation of the ventral surface of the third maxillipeds, in that respect resembling *P. gracilis*. With *P. hagenianus* alone, it shares two spines projecting beyond the distal margin of the inner ramus of the uropods. Its suborbital angle allies it with all of the members of the Section except *P. hagenianus*.

It may be readily distinguished from all of its relatives by the following: the short fingers of the chela which are subequal in length to the mesial margin of the palm; in the males, hooks are present on the ischia of the fourth pereopods rather than on the third, and the coxae of the fourth pereopods bear prominent caudally projecting prominences; the pleopod of the first form male lacks a distinct caudal process, and the centrocephalic process is broad and bladelike.

*Life History Notes:* First form males have been collected in February, June, and July; no females carrying eggs or young have been found.

*Habits:* All of the specimens for which detailed data are available were collected from comparatively simple burrows which are subject to being flooded following rains. Whether or not the species is largely confined to burrows, as is the neighboring *P. hagenianus*, is not known.

*Remarks:* Deciphering the identity of one of the four elements constituting the terminal portion of the first pleopod has been difficult. There seems to be no question as to the homologies of three of them (mesial, cephalic, and centrocephalic processes); however, the relationship of the remaining terminal to the centrocephalic process and its superficial, at least, resemblance to the caudal process of the pleopods of the members of the Gracilis Section, presents a real problem of interpretation: Is it the caudal or centrocaudal process? In the usual sequence in which the processes appear (Hobbs, 1940) spiraling from the mesial surface, they are as follows: mesial, cephalic, centrocaudal, caudal, and centrocephalic; generally, if any element is lacking, it is either the cephalic or caudal process, and, in all previously described species of the subfamily, the centrocaudal and centrocephalic elements are so arranged that the sperm groove passes between their tips. In *P. fitzpatricki*, the sperm groove does indeed pass between the centrocephalic process and the broad bladelike element (the identity of which is uncertain). Its resemblance to the caudal process of other relatives composing the Gracilis Section tempts one to interpret it as such in spite of its relationship to the centrocephalic process. In making such an interpretation, however, one must concede that it is taking over a function, and absorbing the usual position, both relatively and actually, of the centrocaudal process, thus either replacing or being imperceptibly fused with the latter. To assume that the centrocaudal process is lost would be to attribute to this pleopod an arrangement of the terminal elements which would be unique

in the subfamilies Cambarinae and Cambarellinae. Inasmuch as there are many examples of pleopods in which the caudal process is reduced or entirely absent, but none in which the centrocaudal element is lacking, the process, even though disproportionately large, is adjudged to correspond to the centrocaudal process, and is so treated in the diagnosis and discussion of relationships above. Thus, the caudal element, according to this interpretation, is represented by the narrow ridge at the caudal base of the centrocaudal process.

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